IN THE CLAIMS

The claims are as follows:

1.   (Previously Presented) A method, including:

obtaining V-V intervals between ventricular beats;

computing a first indicated pacing interval, for both a most recent V-V interval concluded by a paced beat and for a most recent V-V interval concluded by a sensed beat, by summing a first addend that includes a most recent V-V interval duration with a second addend that includes a stored previously-computed value of the first indicated pacing interval; and

providing pacing therapy, based on the first indicated pacing interval.

2.   (Previously Presented) The method of claim 1, in which computing the first indicated pacing interval includes:

adjusting the first indicated pacing interval, by an amount based on the most recent V-V interval duration and the previous value of the first indicated pacing interval, if the most recent V-V interval is concluded by an intrinsic beat; and

increasing the first indicated pacing interval, by an amount based on the most recent V-V interval duration and the previous value of the first indicated pacing interval, if the most recent V-V interval is concluded by a paced beat.

3.   (Original) The method of claim 2, in which:

adjusting the first indicated pacing interval includes obtaining a first average of the most recent V-V interval and the previous value of the first indicated pacing interval; and

increasing the first indicated pacing interval includes obtaining a second average of the most recent V-V interval and the previous value of the first indicated pacing interval.

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.111
Serial Number: 09/316515
Filing Date: May 21, 1999
Title: METHOD AND APPARATUS FOR TREATING IRREGULAR VENTRICULAR CONTRACTIONS SUCH AS DURING ATRIAL
ARRHYTHMIA

Page 3
Dkt: 279.112US1

4. (Original) The method of claim 3, in which:

obtaining the first average includes:

applying a first weight to the most recent V-V interval; and

applying a second weight to the previous value of the first indicated pacing interval, in

which the second weight is different from the first weight;

obtaining the second average includes:

applying a third weight to the most recent V-V interval; and

applying a fourth weight to the previous value of the first indicated pacing interval, in

which the fourth weight is different from the third weight.

5. (Original) The method of claim 4, in which the first weight is different from the third

weight.

6. (Original) The method of claim 1, in which computing the first indicated pacing

interval (T_n) is carried out according to $T_n = A \cdot VV_n + B \cdot T_{n-1}$, where A and B are coefficients, VV_n

is the most recent V-V interval duration, and T_{n-1} is the previous value of the first indicated

pacing interval.

7. (Original) The method of claim 6, in which A and B are different values.

8. (Previously Presented) The method of claim 6, wherein computing the first

indicated pacing interval (T_n) includes carrying out the computation according to: $T_n = A \cdot VV_n +$

$B \cdot T_{n-1}$, if VV_n is concluded by an intrinsic beat, otherwise carrying out the computation according

to $T_n = C \cdot VV_n + D \cdot T_{n-1}$, if VV_n is concluded by a paced beat, where C and D are coefficients.

9. (Original) The method of claim 8, in which C and D are different values.

10. (Original) The method of claim 9, in which C and A are different values.

11.   (Original)   The method of claim 8, in which at least one of A, B, C, and D is a function of heart rate.

12.   (Original)   The method of claim 1, in which computing the first indicated pacing interval (T_n) is carried out according to $T_n = a \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, where a and w are coefficients, VV_n is the most recent V-V interval duration, and T_{n-1} is the previous value of the first indicated pacing interval.

13.   (Original)   The method of claim 12, in which a is greater than a value selected from the group consisting of 0.5 and 1.0.

14.   (Original)   The method of claim 13, in which a is approximately equal to 1.1.

15.   (Previously Presented) The method of claim 12, wherein computing the first indicated pacing interval (T_n) includes carrying out the computation according to: $T_n = a \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, if VV_n is concluded by an intrinsic beat, otherwise carrying out the computation according to $T_n = b \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, if VV_n is concluded by a paced beat, where b is a coefficient.

16.   (Original)   The method of claim 15, in which a and b are different values.

17.   (Original)   The method of claim 16, in which a is greater than a value selected from the group consisting of 0.5 and 1.0.

18.   (Original)   The method of claim 17, in which b is greater than a.

19.   (Original)   The method of claim 16, in which b is greater than a.

20.   (Original)   The method of claim 16, in which a is approximately equal to 1.1 and b is approximately equal to 1.2.

21.   (Original)   The method of claim 15, in which at least one of a, b, and w are a function of heart rate.

22.   (Original)   The method of claim 12, in which w is approximately between 0 and 1.

23.   (Original)   The method of claim 1, in which providing pacing therapy is also based on a second indicated pacing interval that is based on a sensor.

24.   (Original)   The method of claim 23, in which providing pacing therapy is based on the shorter of the first and second indicated pacing intervals.

25.   (Original)   The method of claim 24, in which the first and second indicated pacing intervals do not fall outside a range bounded by intervals corresponding to upper and lower rate limits.

26.   (Previously Presented) The method of claim 1, in which computing the first indicated pacing interval includes limiting the first indicated pacing interval to be longer than or equal to an interval corresponding to an upper rate limit.

27.   (Previously Presented) The method of claim 1, in which computing the first indicated pacing interval includes limiting the first indicated pacing interval to be shorter than or equal to an interval corresponding to a lower rate limit.

28.   (Previously Presented) A method, including:
       detecting an atrial tachyarrhythmia;
       triggering a rate stabilization mode, when the atrial tachyarrhythmia is present, that includes computing a first indicated pacing interval value;
       obtaining V-V intervals between ventricular beats;

computing the first indicated pacing interval by summing a first addend that includes a most recent V-V interval duration with a second addend that includes a previous value of the first indicated pacing interval; and

providing pacing therapy, based on the first indicated pacing interval, when the atrial tachyarrhythmia is present.

29.   (Previously Presented) The method of claim 28, in which computing the first indicated pacing interval includes:

adjusting the first indicated pacing interval, by an amount based on the most recent V-V interval duration and the previous value of the first indicated pacing interval, if the most recent V-V interval is concluded by an intrinsic beat; and

increasing the first indicated pacing interval, by an amount based on the most recent V-V interval duration and the previous value of the first indicated pacing interval, if the most recent V-V interval is concluded by a paced beat.

30.   (Previously Presented)   The method of claim 29, in which:

adjusting the first indicated pacing interval includes obtaining a first average of the most recent V-V interval and the previous value of the first indicated pacing interval; and

increasing the first indicated pacing interval includes obtaining a second average of the most recent V-V interval and the previous value of the first indicated pacing interval.

31.   (Original)   The method of claim 30, in which:

obtaining the first average includes:

applying a first weight to the most recent V-V interval; and

applying a second weight to the previous value of the first indicated pacing interval, in which the second weight is different from the first weight;

obtaining the second average includes:

applying a third weight to the most recent V-V interval; and

applying a fourth weight to the previous value of the first indicated pacing interval, in which the fourth weight is different from the third weight.

32.   (Original)   The method of claim 31, in which the first weight is different from the third weight.

33.   (Original)   The method of claim 28, in which computing the first indicated pacing interval (T_n) is carried out according to $T_n = A \cdot VV_n + B \cdot T_{n-1}$, where A and B are coefficients, VV_n is the most recent V-V interval duration, and T_{n-1} is the previous value of the first indicated pacing interval.

34.   (Original)   The method of claim 33, in which A and B are different values.

35.   (Previously Presented) The method of claim 33, wherein computing the first indicated pacing interval (T_n) includes carrying out the computation according to: $T_n = A \cdot VV_n + B \cdot T_{n-1}$, if VV_n is concluded by an intrinsic beat, otherwise carrying out the computation according to $T_n = C \cdot VV_n + D \cdot T_{n-1}$, if VV_n is concluded by a paced beat, where C and D are coefficients.

36.   (Original)   The method of claim 35, in which C and D are different values.

37.   (Original)   The method of claim 36, in which C and A are different values.

38.   (Original)   The method of claim 35, in which at least one of A, B, C, and D are a function of heart rate.

39.   (Original)   The method of claim 28, in which computing the first indicated pacing interval (T_n) is carried out according to $T_n = a \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, where a and w are coefficients, VV_n is the most recent V-V interval duration, and T_{n-1} is the previous value of the first indicated pacing interval.

40.   (Original)   The method of claim 39, in which a is greater than a value selected from the group consisting of 0.5 and 1.0.

41.   (Original)   The method of claim 40, in which a is approximately equal to 1.1.

42.   (Previously Presented) The method of claim 39, wherein computing the first indicated pacing interval (T_n) includes carrying out the computation according to: $T_n = a \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, if VV_n is concluded by an intrinsic beat, otherwise carrying out the computation according to $T_n = b \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, if VV_n is concluded by a paced beat, where b is a coefficient.

43.   (Original)   The method of claim 42, in which a and b are different values.

44.   (Original)   The method of claim 43, in which a is greater than 1.

45.   (Original)   The method of claim 44, in which b is greater than a.

46.   (Original)   The method of claim 43, in which b is greater than a.

47.   (Original)   The method of claim 43, in which a is approximately equal to 1.1 and b is approximately equal to 1.2.

48.   (Original)   The method of claim 42, in which w is approximately between 0 and 1.

49.   (Original)   The method of claim 42, in which at least one of a, b, and w is a function of heart rate.

50.   (Original)   The method of claim 28, in which providing pacing therapy is also based on a second indicated pacing interval that is based on a sensor.

51.   (Original)   The method of claim 50, in which providing pacing therapy is based on the shorter of the first and second indicated pacing intervals.

52.   (Original)   The method of claim 51, in which the first and second indicated pacing intervals do not fall outside a range bounded by intervals corresponding to upper and lower rate limits.

53.   (Previously Presented) The method of claim 28, in which computing the first indicated pacing interval includes limiting the first indicated pacing interval to be longer than or equal to an interval corresponding to an upper rate limit.

54.   (Previously Presented) The method of claim 28, in which computing the first indicated pacing interval includes limiting the first indicated pacing interval to be shorter than or equal to an interval corresponding to a lower rate limit.

55.   (Original)   A method of providing pacing therapy to a heart, the method including:

   detecting an atrial fibrillation;

   obtaining V-V intervals between ventricular beats;

   computing a first indicated pacing interval (T_n) according to: $T_n = a \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, if VV_n is concluded by an intrinsic beat, otherwise computing T_n according to $T_n = b \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, if VV_n is concluded by a paced beat, where a, b, and w are coefficients, VV_n is a most recent V-V interval duration, and T_{n-1} is a previous value of the first indicated pacing interval; and

   providing pacing therapy, based on the first indicated pacing interval, when the atrial fibrillation is present.

56.   (Original)   The method of claim 55, in which at least one of a, b, and w is a function of heart rate.

57.   (Original)   The method of claim 55, in which a is approximately equal to 1.1, b is approximately equal to 1.2, and w is approximately equal to 1/16.

58.   (Previously Presented) A cardiac rhythm management system, including:

      a ventricular sensing circuit for sensing ventricular beats;

      a controller, obtaining V-V intervals between ventricular beats and computing a first indicated pacing interval, for both a most recent V-V interval concluded by a paced beat and for a most recent V-V interval concluded by a sensed beat, by summing a first addend that includes a most recent V-V interval duration with a second addend that includes a stored previously-computed value of the first indicated pacing interval; and

      a ventricular therapy circuit, providing pacing therapy based on the first indicated pacing interval.

59.   (Previously Presented) The system of claim 58, in which the controller adjusts the first indicated pacing interval, by an amount based on the most recent V-V interval duration and the previous value of the first indicated pacing interval, if the most recent V-V interval is concluded by an intrinsic beat, and the controller increases the first indicated pacing interval, by an amount based on the most recent V-V interval duration and the previous value of the first indicated pacing interval, if the most recent V-V interval is concluded by a paced beat.

60.   (Original)   The system of claim 58, in which the controller computes the first indicated pacing interval (T_n) according to: $T_n = a \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, if VV_n is concluded by an intrinsic beat, otherwise T_n is computed according to $T_n = b \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, if VV_n is concluded by a paced beat, where b is a coefficient.

61.   (Original)   The system of claim 60, in which at least one of a, b, and w is a function of heart rate.

62.   (Original)   The system of claim 58, further including a sensor, and in which the controller computes a second indicated pacing interval based on signals received from the sensor, and in which the ventricular therapy circuit provides pacing therapy that is also based on the second indicated pacing interval.

63.   (Previously Presented) A cardiac rhythm management system, including:

a ventricular sensing circuit;

a controller, the controller including:

a V-V interval timer;

a first register, for storing a first indicated pacing interval; and

a filter, updating the first indicated pacing interval, for both a most recent V-V interval concluded by a paced beat and for a most recent V-V interval concluded by a sensed beat, by summing a first addend including the most recent V-V interval stored in the V-V interval timer with a second addend including the previously-computed stored value of first indicated pacing interval stored in the first register; and

a ventricular therapy circuit, providing pacing therapy based at least partially on the first indicated pacing interval.

64.   (Original)   The system of claim 63, further including a sensor, and in which the controller further includes a second register, for storing a second indicated pacing interval that is based on a signal received from the sensor, and in which the ventricular therapy circuit provides pacing therapy based on one or more of the first and second indicated pacing intervals.

65.   (Original)   The system of claim 64, further including an atrial sensing circuit and an atrial tachyarrhythmia detection module, and in which the selection module selects the first indicated pacing interval as the selected indicated pacing interval during an atrial tachyarrhythmia.

66.   (Original)   The system of claim 65, in which the selection module selects the second indicated pacing interval as the selected indicated pacing interval when no atrial tachyarrhythmia is detected.

67.   (Previously Presented) The system of claim 64, in which the filter includes an infinite impulse response (IIR) in updating the first indicated pacing interval based on the V-V interval timer and the first register.

68.   (Previously Presented) The system of claim 64, in which the filter includes a finite impulse response (FIR) in updating the first indicated pacing interval based on the V-V interval timer and the first register.

69.   (Previously Presented) The system of claim 64, in which the filter includes an averager in updating the first indicated pacing interval based on the V-V interval timer and the first register.

70.   (Previously Presented) The system of claim 69, in which the filter includes a weighted averager in updating the first indicated pacing interval based on the V-V interval timer and the first register.

71.   (Original)   The system of claim 63, in which the filter updates the first indicated pacing interval (T_n) according to $T_n = A \cdot VV_n + B \cdot T_{n-1}$, where A and B are coefficients, VV_n is the V-V interval duration provided by the V-V interval timer, and T_{n-1} is the previous value of the first indicated pacing interval.

72.   (Original)   The system of claim 71, in which A and B are different values.

73.   (Previously Presented) The system of claim 71, wherein the filter updates the first indicated pacing interval (T_n) according to the: $T_n = A \cdot VV_n + B \cdot T_{n-1}$, if VV_n is concluded by an intrinsic beat, otherwise the filter updates T_n according to $T_n = C \cdot VV_n + D \cdot T_{n-1}$, if VV_n is concluded by a paced beat, where C and D are coefficients.

74.   (Original)   The system of claim 73, in which at least one of A, B, C, and D is a function of heart rate.

75.   (Original)   The system of claim 74, in which C and D are different values.

76.   (Original)   The system of claim 74, in which C and A are different values.

77.   (Previously Presented) The system of claim 63, in which the filter updates the first indicated pacing interval (T_n) according to $T_n = a \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, where a and w are coefficients, VV_n is the V-V interval duration provided by the V-V interval timer, and T_{n-1} is the previous value of the first indicated pacing interval.

78.   (Original)   The system of claim 77, in which a is greater than a value selected from the group consisting of 0.5 and 1.0.

79.   (Original)   The system of claim 78, in which a is approximately equal to 1.1.

80.   (Previously Presented) The system of claim 77, wherein the filter updates the first indicated pacing interval (T_n) according to the: $T_n = a \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, if VV_n is concluded by an intrinsic beat, otherwise the filter updates T_n according to $T_n = b \cdot w \cdot VV_n + (1-w) \cdot T_{n-1}$, if VV_n is concluded by a paced beat, where b is a coefficient.

81.   (Original)   The system of claim 80, in which at least one of a, b, and w is a function of heart rate.

82.   (Original)   The system of claim 80, in which a and b are different values.

83.   (Original)   The system of claim 82, in which a is greater than 1.

84.   (Original)   The system of claim 83, in which b is greater than a.

85.   (Original)   The system of claim 82, in which b is greater than a.

86. (Original) The system of claim 82, in which a is approximately equal to 1.1 and b is approximately equal to 1.2.

87. (Original) The system of claim 80, in which w is approximately between 0 and 1.

88. (Original) The system of claim 63, further including a leadwire adapted for coupling at least one of the ventricular sensing circuit and the ventricular therapy circuit to a heart.

89. (Original) The system of claim 63, further comprising a remote programmer, adapted for communication with the controller.

90. (Original) An implantable cardiac rhythm management device, including:

a ventricular sensing circuit;

an atrial sensing circuit, for detecting an atrial tachyarrhythmia;

a sensor;

a controller, the controller including:

a V-V interval timer;

a first register, for storing a first indicated pacing interval;

an infinite impulse response (IIR) filter that updates the first indicated pacing interval (T_n) according to: $T_n = A \cdot VV_n + B \cdot T_{n-1}$, if VV_n is concluded by an intrinsic beat, otherwise is updated according to $T_n = C \cdot VV_n + D \cdot T_{n-1}$, if VV_n is concluded by a paced beat, where A, B, C and D are coefficients, and VV_n is the V-V interval duration provided by the V-V interval timer, and T_{n-1} is the previous value of the first indicated pacing interval;

a second register, for storing a second indicated pacing interval that is based on a signal received from the sensor; and

a selection module, selecting the shorter of the first and second indicated pacing intervals, when an atrial tachyarrhythmia is detected, to provide a selected indicated pacing interval, and selecting the second indicated pacing interval, when no atrial tachyarrhythmia is detected; and

a ventricular therapy circuit, providing pacing therapy based on the selected indicated
pacing interval.

91.   (Previously Presented) A cardiac rhythm management system, including:

a ventricular sensing circuit;

a controller, the controller including:

a V-V interval timer;

a first register, for storing a first indicated pacing interval;

means for updating the first indicated pacing interval, for both a most recent V-V interval

concluded by a paced and for a most recent V-V interval concluded by a sensed beat, by

summing a first addend including a most recent V-V interval duration with a second

addend including a stored previously-computed value of the first indicated pacing

interval; and

a ventricular therapy circuit, providing pacing therapy based at least partially on the first
indicated pacing interval.